REALIZING ON OUR INVESTMENT IN AGRICULTURAL RESEARCH

Talk by Dr. E. C. Elting, Deputy Administrator for Experiment Stations, Agricultural Research Service, U. S. Department of Agriculture, before the Joint Conference of Directors of Extension and Experiment Stations of the Southern States, College Station, Texas, April 11, 1956.

What are we getting for our research dollar?

To get at this answer, we have first to consider how much we have invested in agricultural research.

First, let's look at the Federalinvestment. Federal funds allotted to agricultural research have increased steadily for the past several years. The appropriation this year for agricultural research is $83,431,000 -- double the amount used only 10 years ago and five times that appropriated 20 years ago. For fiscal year 1957, the budget request was for an increase of 23 percent -- for a total of about $103 million.

This year's $83 million includes $58½ million used by agencies within the Department and $24½ million allocated to the State agricultural experiment stations.

Percentage-wise, each year the States are getting more and more of the Federal funds. This year, the States received nearly 30 percent of the total as compared with a little more than 20 percent 10 and 20 years ago. Next year the States again will receive 30 percent.

What about the States' investment? This year the States have available $77 million -- well over three times as much as they had 10 years ago, and seven times expenditures 20 years back.

Altogether -- State and Federal -- this year we are spending some $160 million for agricultural research. This amounts to about 96 cents a person a year. Of this about 50 cents comes from the Federal Government, and the rest -- 46 cents -- from the States.

Now, then, are we getting our money's worth? Exactly what are our dividends on this 96-cent investment that each of us has in agricultural research?

Before we start checking our research account, let me point out that research standing alone is not enough. The useful knowledge gained in laboratories and experimental plats must be passed on to the people who need it. For that we need the channels of education and information provided by the Federal State cooperative extension service. As we consider some of the improvements of the past few years, you will recognize that without Extension education many of these might not have taken place, and certainly not so speedily.

It is impossible to evaluate in dollars and cents all of the dividends we have been collecting on our past and current investments in

research. But we can look at some of our accomplishments -- as shown on some slides I want to present -- and measure our gains with the past.

First, let's look at the overall changes in agricultural productivity.

During the past 20 years, while population increased 25 percent, total farm output went up 42 percent. Several factors influenced this increase. Probably the main ones were:

1. Stepped up demands during and after World War II.

2. Increased mechanization.

3. Advances in agricultural know-how initiated through research.

4. Release of millions of acres, once needed to support work animals, for the production of marketable commodities.

In 1935, one farm worker could produce enough food for 10 persons. Now, even with slightly shorter working hours, he raises enough food for 18 people.

These gains show up like this in farm production per unit. In 20 years, farmers have increased the yields of crops per acre by 27.5 percent. Livestock producers are now raising five animals for every four produced in 1935.

At the same time, changes have taken place in our eating habits. Many have come about as the result of nutrition studies. Advances in processing, transporting and marketing have contributed to the shifts. Higher incomes enabled consumers to change their food buying habits.

This chart shows the percent change in 1954 from 1935-39 in the per capita consumption of major food groups. The increases were in meat, fish and poultry; dairy products; eggs; fruits and vegetables; and sugar and sirups -- the highest, by far, being the 46 percent gain in consumption of eggs. The decreases were in fats and oils, including butter; potatoes and sweetpotatoes; dry beans, peas and nuts; and flour and other cereal products. The greatest decrease -- 29 percent -- was in potatoes.

In other words, the changes were from fats and starches to increases in fruits and vegetables, and high protein foods. Agriculture is having to adjust to meet these changes in consumer demand and research is helping.

Now, let's look at some of the specific improvements in farm production where research has played a major role.

Heavier feeding, better balanced rations, better breeding, better sanitation and improved livestock management in general helped to increase

livestock production per breeding unit by 25 percent in the past 20 years.

The sharpest increase was in egg production -- 51 percent in 20 years ... or five dozen more eggs per hen a year. Milk production per cow went up 32 percent and pork per sow 20 percent.

The most spectacular gains have been made in broiler production. Twenty years ago, broiler production was a fringe farm operation worth $24 million to farmers. Today, it is a highly commercialized business. In 1954, it grossed $800 million. Production has increased by almost 2400 percent. This is a record few agricultural enterprises can match. Research made it possible ... and here's how.

Broiler production has moved up in step with advances in poultry nutrition and feed efficiency. A grower today can produce 42 percent more meat from the same amount of feed he used 20 years ago.

The "chicken of tomorrow" is here today in the form of vigorous hybrids favored in poultry markets. Research has added so much new information on poultry nutrition, that the 1954 ration gives a half-pound more poultry meat in 9 weeks on a half-pound less feed than did the 1935 ration. These broilers were photographed at the Maryland Experiment Station.

Labor efficiency in producing broilers has improved by far greater margins than that for other livestock enterprises. Automatic equipment, greater nutrition efficiency, disease control, and a 30 percent shortening of time needed to produce a 3-pound broiler -- all the outgrowth of research activities -- have brought about this 162 percent gain in man-hour productivity.

Beef cattle and hog producers haven't had the lift that milking machines and greater production per cow have given to dairymen. Beef cattle and hogs are fed and handled much the same as they were 20 years ago.

Now let's consider some of the crops. Research made it possible for the soybean to rise from relative obscurity and become a major crop during the past 20 years.

Research provided the necessary information on seeding, inoculation, fertilizing, and liming to make soybeans a profitable source of income to farmers where soybeans had never been grown a few years ago. Even more significant, research produced hybrid varieties that yield higher by 20 percent; resist shattering and lodging; and mature within the growing seasons of various new production areas. Today, the soybean has hundreds of food and industrial uses.

Soybeans, on this chart, show less improvement in per acre yields than do any of the major crops -- corn, cotton, wheat, hay and oats.

But you can see that farmers are producing more to the acre than they did 20 years ago. New crop varieties, greater use of commercial fertilizer, better insect and disease control -- products of research activity -- are behind this uptrend. The net result is a 40 percent gain in total farm output, although total acres used for crops changed only slightly.

Let's take a closer look at one of these factors -- new crop varieties.

Since 1935, the change in varieties has been greatest in sugar beets -- an estimated 100 percent. There has been a 95 percent change in varieties of sugarcane and sorgo, and 96 percent for all sugar crops. Flax varieties have changed 99 percent; soybeans, 98 percent; and oats, 92 percent. Eighty percent of the wheat acreage and 86 percent of the corn acreage is in new varieties.

In hay crops, where less research has been conducted, farmers are still using mostly the same varieties they planted 20 years ago.

As you well know, better crops are the result of cooperative Federal and State research programs. They have sought out new germ plasm; adapted foreigh crop plants, such as soybeans, to our climate and methods of farming; fixed resistance to various diseases and insect pests in established crops; and "tailored" crops to fit machine operations on farms. A familiar example of this is the work done in grain sorghums. A few years ago, sorghums grew 7 feet high, were top heavy, and had to be harvested by hand. Plant breeders brought these plants down to a 3-foot high sorghum that stands straight and can be harvested with combines. I think it is appropriate to mention grain sorghums at this point because of the valuable pioneering work done here in Texas in the breeding of sorghum crops. The dividend: Farmers save 75 hours of work in producing 100 bushels of grain. But progress is not ended. Hybrid grain sorghums are now on the way.

About 70 percent of all crop acreage in 1954 was planted to varieties not even in existence commercially 20 years earlier. In some cases, varietal shifts have occurred two or three times.

The experience of oat growers in Iowa is a good example. They have made a complete changeover twice since 1941 in oat varieties. A third major shift is now under way -- part of the endless battle to keep ahead of crop diseases.

You can see by the chart that it took only 4 years for crown-rust resistant Victoria strains to displace Kherson oats. When improved Bond strains, resistant to Helminthosporium blight came out, they took over in 3 years. The present change is slower, but new varieties such as Clintland already occupy one acre in five.

Plant breeders are racing against time to develop still better varieties growers will need as other disease organisms build up.

These results indicate that up to now our chief dividends have been in terms of greater total output and marked improvement in quality. If production research needed any defense -- and I don't propose that it does -- the improvement in quality alone would justify our expenditures.

In the face of bigger and better yields, however, many people are asking how we can justify continued and increased research in times of agricultural surplus.

There is no single or simple solution to this problem. Surpluses are not necessarily permanent. A national emergency or extremes of weather could reduce our margin considerably, or wipe it out. We can expect ups and downs in our supplies and can look to research to help cushion our economy against their shocks.

Today's surpluses are a challenge to find ways to adjust farm production to the demand, increase farm efficiency, and maintain the rate of gain our population and economy require.

Since 1952, our joint State-Federal research programs have been given a change of direction to concentrate on cutting farm production costs, improving quality, developing new crops, and getting new customers.

One of the biggest drains on farm efficiency is the amount of hand labor and chore time still required in many farm operations. You and your associates are looking for ways to reduce these. You are testing ways to use more forage to produce -- not more beef -- but beef of better quality more cheaply. You are developing chemical weed-control practices to reduce tillage.

Plant breeders are looking for corn with more protein, cotton with extra strength, and vegetables with better freezing quality.

Research showed that protein content in commercial starter mashes and broiler feed might be reduced from 21 percent to 19 percent by the use of antibiotics. This cut of 2 percent, when applied nationally, amounts to a saving of 125,000 tons of high cost protein feed -- a tidy saving from one research finding.

One function of research is to explore every avenue to develop new and better uses for agricultural products. Our joint programs are putting special emphasis on those farm products now in surplus.

In the Southern Regional Research Laboratory, chemical finishes are being developed for cotton fibers that make them competitive with other fibers in various markets. The composition of corn, wheat, cotton and other products is under study to learn more about their physical and chemical properties. Through chemistry, new qualities are being developed in wool fiber for specific market uses.

New crops like ramie and kenaf are being studied as possible substitutes for jute and other imported fibers, and timber bamboo as a

possible new source of paper pulp. While I am not looking into the crystal ball, some of these new crops may become replacements for what are now surplus crops in certain areas, as did the soybean. Research on the soybean developed varieties that now occupy 18 million acres -- formerly in corn and other crops. Research found hundreds of industrial uses for it, the most recent being its use in dripless paint.

We are all aware of the keen public interest in ways and means of relieving the problems of surpluses in our agriculture. There is plenty of evidence to that effect -- including the current proposal before Congress for a $100 million "crash program" of research to find new and expanded industrial outlets for grains and other surplus farm products.

We know, of course, that research cannot be static -- it must go forward. And it must go forward on all fronts. Marketing research also must play a vital role in cutting costs from farm to consumer. Recent studies of bulk delivery of feed and bulk handling of citrus fruits in groves are bringing direct savings to farmers. Every saving in the handling and distribution of farm products, or in the preservation of quality during marketing, is an extra dividend from our research investment.

In these days of tremendous change in our farm economy, we are concerned not only that our research keep up -- we know that it must set the pace. A strong, cooperative research program, accompanied by an equally strong educational program in Extension, is a vital safeguard for our economy.

The 70-year record of the State experiment stations and the Department in conducting agricultural research is proof of these words. We are daily "clipping coupons" on the research investment in the form of an agriculture that can produce ample food for our needs, in the preservation of farming as a free family enterprise, and in our ability to help farmers maintain their position economically and socially with other segments of our economy.

I would say we are getting a lot for our research dollar.

PANEL DISCUSSION: GOVERNMENT-UNIVERSITY-INDUSTRY COOPERATION IN AGRICULTURAL RESEARCH

Presentation by

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This subject is of continuing significance to the membership of the Agricultural Research Institute.

I have bracketed the government research agencies -- primarily the U.S. Department of Agriculture -- and the university laboratories -- primarily State agricultural experiment stations -- as publicly supported research institutions, and have assumed that each has similar objectives and problems in developing cooperative relationships with industry.

In approaching the subject of cooperation in agricultural research, I should like to cite a few statistics that will help to put our discussion in perspective in relation to the total national effort in research and development. To say that this total effort has accelerated rapidly during the post war years is an understatement. Information recently released by the National Science Foundation indicates that during the decade 1951-52 through 1960-61, about $80 billion were spent for research and development in the United States. This figure is approximately double the amount spent during the preceding decade. Continuing the trend, an additional $15 billion is estimated to have been obligated during the 1961-62 fiscal year recently ended.

Some breakdown of these gross figures will help to understand their significance. The total research and development funds amounted to 1.41 percent of the gross national product during 1953-54, but had increased to 2.78 percent during the year 1960-61. It is obvious, therefore, that there is increased emphasis on research and development as a major component of the Nation's economy.

If we reexamine these data as to the source of our research and development dollars during 1960-61, the last year on which detailed statistics are reported, here is what we find: Out of approximately $14 billion in all, the Federal government provided $9.2 billion, industry $4.5 billion, colleges and universities $.2 billion, and other non-profit institutions $.1 billion.

American industry spent some $10.5 billion of this total, $6.1 billion of which was provided by the Federal government and $4.4 billion by industry itself.

Examining the distribution of these research and development expenditures by industry, we find that the latest available data show 4% of the total expended for basic research, 20% for applied research, and 76% for development. Comparable figures on the use of the Federal research appropriations to the USDA show approximately 28% for basic research, 68% for applied research, and 4% for development.

Talk before the annual meeting of the Agricultural Research Institute, Washington, D. C., October 16, 1962.

There is evidence that expenditures by the State agricultural experiment stations break down in this same general order.

One other comparison seems significant. Of our total funds for research and development, the Federal government provides about 64%, State governments and non-profit institutions about 3%, and industry about 33%. However, in research and development relating to food, agriculture, and forestry, the Federal government provides about 22% of the total, States about 20%, and industry 58%.

Thus, as we approach the subject of cooperation between public institutions and industry in the field of agricultural research, we recognize the very substantial contribution which industry is making to this area.

The program committee has posed a number of penetrating questions to this panel. These questions are largely subjective in nature and it is entirely possible that the answers which I or other members of the panel may give to these questions will not be acceptable to you. We trust, however, that they will stimulate discussion of these important questions to the end that more effective relations and stronger cooperation may be developed among these three partners in agricultural research.

They ask first, "Is it true that more and more research projects are worked on cooperatively by government, universities, and industry?"

Only limited statistics are available to answer this question in the strictly comparative framework in which it is asked. Research has expanded significantly in recent years, in both the privately and publicly supported sectors, so that even if there has not been a significant percentage increase in cooperation, there has been a significant increase in the number of cooperative projects. Actually, there is evidence that an increasing percent of industry research is correlated with similar research conducted by the State stations and the Department. However, there is still room for further cooperation, since it was estimated last year that only about 10% of industry's research was thus highly correlated.

In response to the second part of this question as to how strong is this trend of increased cooperation, I can only express the opinion "not strong enough." I urge that effort be made to accelerate the rate at which these cooperative relationships are developed. In making this statement, I tend to give an affirmative answer to the second question, which asks, "Is there a need for general cooperation in agricultural research between these various agencies?"

The following areas of need are described to support my affirmative answer. Sound economics dictate that there should be close cooperation between these research agencies wherever mutuality of interest exists. It is the only way to assure maximum returns for research and development dollars whether they be derived from public or private sources.

The evidence of strong cooperative relations between industry and our public agencies tends to promote greater public confidence in agricultural research. It may well be that this need for gaining public confidence is one of the most compelling reasons for close cooperation. We can point to many sectors where it is highly essential in terms of the public image and public understanding of vital problems that this type of close cooperation between our public and private agencies should exist.

To support this point of view, I quote from a recent communication from Dean Leland G. Merrill, Jr., New Jersey College of Agriculture, commenting on a paper which he presented at a recent meeting of the National Agricultural Chemical Association at Spring Lake, New Jersey, on September 5 of this year. He says, "To me, the major problem is not in the technical phases, but that a cultural gap exists in public knowledge of use of chemicals." He sees this as a serious and long-term problem which should be systematically attacked by all the agencies concerned.

What has been said of pesticide chemicals is quite as true of the role of saturated fats in the human diet or of additives in the rations of farm animals. In all of these areas where our knowledge is inadequate, the first obvious need is for continued objective research to seek sound answers to complicated problems. Joined with this effort is the need for the use of every skill at our command in creating a proper public understanding of the problems and issues involved.

Your program chairman then moves to questions regarding advantages and disadvantages which surround the development of cooperative effort. I cite the following areas in which we can point to definite advantages of close cooperation between industry and public research. While the illustrations used are taken from a 1960 study of industry-Department cooperation, we know that many of these examples and others of comparable significance are applicable to industry-Experiment station cooperation.

a. Permit more intensive work and speeding up of research achievement. Many of the research problems with which the Department is concerned require intensive work to obtain positive results in a short time. Industry can and has contributed in some of these efforts. For example, with funds and facilities provided by the Cotton Council of America for research at Iguala, Mexico, it has been possible to cut the time in half for the initial development of segregating populations of cotton and subsequent release of a commercial variety resistant to bacterial blight, and to speed up the development of lepidopterous-insect-resistant and gossypol-free lines. At the Clemson, South Carolina, laboratory for ascertaining cotton qualities in spinning and weaving, the Council has provided funds to permit double-shift operations of equipment to speed the attainment of results.

b. Provide services of specialized personnel and facilities and equipment. In a number of the Department's research programs, industry is providing to a limited extent services of specialized personnel and, more generally, facilities and equipment. Cooperation on these items is extremely valuable. Pertinent examples are as follows: the American Sugar Beet Growers Association is supplying services of two scientists with unique background in monogerm sugar beet breeding and cytology to help evaluate hundreds of hybrid progeny, two additional professionals for chemical evaluations, equipment which is not available in the Department, and seed of new and promising varieties.

c. Expedite getting research results adopted by industry. When industry cooperates in research, results are likely to be more quickly adopted by industry. Close association of cotton gin manufacturers and Department researchers has speeded up the development of ginning equipment and, especially, modification of hundreds of existing gins. More spectacular has been the adoption of aerosol units. Following the development of the aerosol principle by Department scientists, industry has assisted greatly in the development of better units and in exploiting the results of basic research. From 1947 to the present time, the aerosol industry has increased production from 1 million to more than 400 million units annually.

d. Permit coverage of a larger number of problems. The Department is responsive to proposals from industry for research on cooperative projects of mutual interest which are in accord with the objectives of the regular programs. In these instances, industry may make available small amounts of chemicals and biological materials not available on the open market or supply limited radioactive tracer materials. The successful quest for a suitable antioxidant to help stabilize the nutrients in dehydrated alfalfa feed was realized through cooperation of many chemical manufacturers. Today's frozen citrus juice concentrate industry, with a cumulative product value exceeding $1.5 billion, stemmed from the cooperative efforts of the Florida Citrus Commission, many representatives of the industry, and Department personnel. In other instances the Department may supply only the know-how. The mutual sharing of ideas, manpower, materials and funds permits greater coverage of a larger number of problems.

e. Make important information and data accessible. An inestimable advantage accrues from access by Department scientists to information and data not otherwise available. Cost data from individual firms are absolutely essential for many market and price analyses. In other instances, data acquired by industry effectively supplement Department research. For example, the American Bankers Association semi-annually collects data from approximately 5,000 banks in agricultural areas to determine the adequacy of agricultural credit, delinquency of payments, major purposes for which loans were made, interest rates on new real estate and mortgage loans and associated agricultural problems. These data are made available to enable researchers to prepare more complete reports on farm costs and agricultural finance. Additional pertinent examples would include information supplied by industry making possible

the development of substantially improved procedures for conditioning and drying of cereal grains such as corn, wheat, and rice; and industry research and practical plant data in expediting USDA efforts to improve and stabilize flavor of edible products from vegetable oils and animal fats.

f. Provide more equitable financing for research. In view of the many segments of research for which public agencies are responsible and the urgent problems which have to be solved quickly, it is evident that funds and facilities are inadequate to meet all demands. For fiscal year 1960, for example, the Research Advisory Committees recommended a total of 670 problems on which research should be initiated or expanded. Appropriation of public funds permits the initiation or expansion of a relatively few of these recommended projects. Priority is given to projects having the broadest interests in terms of commodities, functions, beneficiaries or geographic distribution. Projects advocated by narrower interests may be undertaken only with financial aid from those most interested. Public financial support must, as a matter of equity, be limited where only a few primary beneficiaries are likely to be involved. Accordingly, industry's contributions in making available equipment and facilities, synthesis of and development of pesticides, antibiotics, and food and feed additives permit more equitable financing for research on specific projects. Similarly, market research on products grown by only a few farmers can hardly be justified on a large scale without their participation.

g. Lessen the demand for public funds to be appropriated for research. It is estimated that $20,000,000 are spent annually by industry in the synthesis and development of chemicals for the control of insects, plant and animal diseases, weeds and internal and external parasites of animals. The Department's responsibility in the over-all cooperative effort is for research on the final evaluation of the procedures and results submitted in substantiation of claims of efficacy, safety and compliance with legal requirements. Thus, with industry bearing a major share of responsibility and cost of the program, the demand for public funds for this research is lessened.

Legislators express the feeling that if industry were to do more, public agencies might do less research. This may be true provided the public is willing to wait until industry is ready to perform, disclose, or adopt research that could conceivably be done by industry. Actually, government research in such areas as marketing stimulates rather than replaces industry research. It is so highly dependent upon industry cooperation that the two supplement rather than substitute for each other.

h. Provide avenue for public-spirited groups or individuals to aid agriculture. Department researchers have profited in many ways from contributions to public research programs. Frequently, as might be expected, the donors also profit. Nevertheless, contributions from these sources have been valuable in expediting certain of our programs. Farmers often donate land for crop testing programs. Flocks of sheep and grazing lands have been made

available by public-spirited sheepmen to assist the Department in its studies to determine effects of environment and diet upon wool processing quality. Recently American interests donated facilities in Venezuela for screening the world collection of rice varieties to determine resistance to a destructive virus disease which at the time was not present in the United States. Likewise, recently a public-spirited citizen donated $145,000 in partial support for converting Dairy Herd Improvement data processing to electronic equipment.

There are disadvantages accruing from such cooperative effort only if we fail to recognize certain pitfalls that can become a deterrent to effective relations.

Most of those who make suggestions for new or additional work to Congress, to the Department, or to State stations have some knowledge of the kinds of research conducted in industrial laboratories. They do not usually urge upon public agencies work that industry is likely to undertake. The principal exceptions are large groups of individuals or small firms who are at a disadvantage in relation to large corporations that have their own research laboratories. Some suggestions come from leaders in industrial laboratories. They visualize the long-term public benefits from investigations which they do not undertake themselves, because the results cannot be protected for the short-term benefit of the firm.

Probably each of you, drawing on your experience, can point to certain areas where we need to be on guard in the development of cooperative relations. Some of these are expressed in a recent policy statement relating to the acceptance by the U.S. Department of Agriculture of contributions to research, as follows:

a. There shall be mutuality of substantive interest, with the exception that the public interest will be definitely served.

b. The research shall be directed toward the solution of problems of agriculture including the production, processing, utilization, distribution and consumption of the product of agricultural and forest lands.

c. The research, whether basic or applied, shall be designed to add to the fund of scientific knowledge.

d. Preference shall be given to research that promises the most widespread benefits. The objective of the research shall not be limited to the interest of an individual or single firm.

e. Research for which contributions may be accepted shall be within the boundaries of an agency's approved program. No research shall be completely supported by contributions.

f. Results shall be subject to public disclosure. Publication of research results is the usual, but not the only, method for assuring wide availability to the public. Patentable ideas, products, processes, and equipment developed

in the course of the research shall be reserved to the public in accordance with existing laws and regulations and this reservation shall be inserted in agreements covering research. Results shall not be presented in such a way as to constitute endorsement by the Department of any proprietary product or process.

I know that most experiment station administrators likewise have developed carefully drawn statements of policy under which their institutions will accept contributions from industry for the support of research.

The final point raised by your program chairman is whether industry burdens the State and Federal research agencies with too much product testing. I feel strongly that a categorical "yes" or "no" answer fails to recognize the many conditions that must determine the proper role of the public agency and of industry in developing the machines and products which make such important contributions to our expanding agricultural technology.

Let us consider the area having to do with the selecting and evaluation of pesticide chemicals for research and use in agriculture. The following excerpts from a recent report from the Department to an inter-Departmental committee established by the Director of the Office of Science and Technology, in my judgment, puts this problem in proper perspective:

> "The U.S. Department of Agriculture and the State agricultural experiment stations are interested in fundamental and applied research on the development of chemicals that may be useful in agriculture, especially those which have a low order of toxicity to man, livestock, wildlife, to crop and forest plants and soil microorganisms. ...
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> "Most of the chemicals ... are synthesized and developed by industry. In some instances, the public research agencies aid in their commercial development; in others, the chemicals have been discovered by public agencies with subsequent commercial development by industry. Department programs of synthesis and analysis relate for the greater part to long-term basic problems such as those resulting from chemical investigations of naturally occurring products, attractants, repellents, synergists and chemosterilants. They also relate to certain classes of chemicals of importance to agriculture or to specific pest control programs in which the Department is engaged.
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> "The responsibilities of the public agencies include research on chemicals for which there is a limited market potential.
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> "Department and State scientists obtain candidate chemicals from industry and from Federal and State agencies. Candidate chemicals are generally not accepted for screening unless they have been shown to possess biological activity. ...

"Upon completion of initial testing, the recipient laboratory submits a report of results to the supplier. The results of such tests by the USDA or State experiment stations are not to be published by the supplier or used for advertising purposes and do not constitute an endorsement of the candidate material by these public agencies. ...

"The results of laboratory and small scale plot tests form the basis for determining the potential value of the chemical. ... Arrangements for large-scale field evaluations may be made with industry if it is mutually determined that such evaluations are justified.

"Industry conducts toxicological investigations in its own laboratories or supports research by other laboratories. The Department of Health, Education, and Welfare alone or in cooperation with industry conducts further toxicological investigations. The Department of Agriculture and State experiment stations conduct and cooperate with industry in the appraisal of the effects of pesticides on livestock.

"In the complex investigations of the residue problem in relation to plant and animal products, the State and Federal agencies usually cooperate with the industrial firm developing the pesticide. ...

"Pesticide uses that are likely to affect adversely the honey bee and other pollinating insects require investigations to determine the effect of the materials on these useful insects. Observations on the effect of pesticides on beneficial parasites, predators, fish and wildlife are often made as pesticide materials are evaluated. ...

"No recommendation for specific use of a chemical is made until the chemical has been registered for such use by the Department of Agriculture in accordance with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act."

Time does not permit further exploration of this area. In the last analysis, the public interest must be served and both the private and public sectors must discharge their appropriate responsibilities. All of us have a stake in delineating those responsibilities.

It is my hope that the position indicated in my remarks to the questions posed by the program committee will stimulate a fruitful discussion here this afternoon.

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PERSPECTIVES IN RESEARCH

Talk by Dr. E. C. Elting, Deputy Administrator of the Agricultural Research Service, U. S. Department of Agriculture, before the Experiment Station staff of the University of Nebraska at Lincoln, Nebraska, January 9, 1959.

This is an exciting time for research. We work in an environment that is generally favorable to the acceptance of new ideas.

Leaders in industry and government hail men and women in science as real benefactors of mankind.

Science is popular with the man in the street. It has given him conveniences that make life more comfortable. It has given him new skills and power over nature. And it has added years to his life.

Modern man's faith in science is reflected in booming investments in research. In fiscal '58 the Federal government's research bill was $3.4 billion. Most of it, to be sure, went for missiles and other products of defense. But there were also increases in the funds for the life sciences and other studies that have a bearing on man's welfare.

This year, Federal and State investments for research in agriculture and forestry total $216 million . . . an increase of $121 million or 127 percent over appropriations for 1948-49 -- just 10 years ago.

More Basic Research

A good sign that people are coming to understand the needs of research is the willingness of the taxpayers and more particularly of their representatives in Congress to invest more public money in basic research, in fundamental studies of natural phenomena.

Less than a century ago, the primary concern of leaders who backed research in agriculture was with practical information. You can see the change in legislation for research.

Dr. James G. Horsfall, Director of the Connecticut Station, reviewed this last fall, in a speech at the Land-Grant College meeting. He pointed out that:

The Hatch Act of 1887 says that grant funds should be used to aid in acquiring and diffusing useful and practical information. There was no mention of understanding nature . . . no reference to basic research.

The Adams Act of 1906 drops the word "diffuse" and mentions original researches and experiments.

The Purnell Act of 1925 is worded similarly, but the Bankhead-Jones Act goes much further. It says the funds shall be used "to conduct researches into the laws and principles underlying the basic problems of agriculture in its broadest aspects."

And finally, the Research and Marketing Act of 1946 gives the basic research man a real charter. It provides for "research into basic laws and principles relating to agriculture."

Other forces have been at work to improve the atmosphere for basic studies . . . for work on the frontiers of science. The level of education has risen both here and abroad. Even more important, we're seeing spectacular returns from what only a few years ago were theoretical studies.

The cultural lag -- between discovery and application -- is steadily decreasing. For instance, 200 years elapsed between the invention of gunpowder in the 12th century and the use of cannons in the 14th. The principles of photography were known 112 years before they were widely applied. Those of the telephone, 56 years, of radio 35 years.

But radar was put to use in 15 years after the principles were fully established -- television within 12 years . . . the atomic bomb in six years . . . transistors within five years.

All of these things have produced a climate of opinion highly favorable to science. This makes it possible for us to embark on ventures in every line of research that would have been out of the question a few years ago because there would have been little support for them.

For instance, the Agricultural Research Service, in the past year-and-a-half, has established 14 laboratories for pioneering research . . . laboratories in which scientists have been chosen for their ability to work on the frontiers of knowledge . . . laboratories in which there are no administrators, only scientists working together.

Other pioneering laboratories will be added . . . the number depending on the needs of the program and on our ability to generate ideas and support them with qualified scientists.

It isn't generally recognized, but the Department of Agriculture is putting a larger share of its funds into basic research than most other Federal agencies.

Out of each dollar obligated for research, the Government as a whole spends 8 cents for basic studies . . . the Department of Agriculture as a whole spends 17 cents . . . and the Agricultural Research Service spends about 25 cents. A recent appraisal of State experiment station research under Federal grants records a similar picture -- 22.3 percent of the total for basic research.

Among officials who set the goals, there's growing support for an investment of 50 percent -- at least half -- of our funds for basic research. And every scientist now being recruited to the staff is considered for his ability to do fundamental work.

Research agencies of the Department will, of course, continue to participate with the States in developmental work on regional and national problems. Finding ways to make use of discoveries in basic research will always be of prime importance in agriculture.

As President Conrad Elvehjem of the University of Wisconsin has said, "There's no better example of the combination of basic and applied research than that conducted in our agricultural experiment stations.

Reorientation of Research

Emphasis on basic research means we must reappraise our program at many points. It influences our choice of people to do the work and also the places where they work.

Scientists doing basic research require an environment that may not be essential to research people in developmental work. For instance, the basic researchers must have an extensive library available to them. They do best in a community of scientists who represent varied disciplines. All are stimulated by the exchange of ideas. Often equipment is so expensive that it must be shared by many workers to justify its purchase.

When the Federal government first began research in agriculture, many problems under consideration could be attacked by one or two workers in an isolated location. This is rarely the case now. The States have built and staffed branch stations and field laboratories and are now well-equipped to handle research formerly done by the Department's field stations.

As agricultural science grows in complexity, we find it advantageous to concentrate our resources, our research people, and equipment in the larger centers.

And that is one of the goals -- more concentration of Federal effort and more stress, where possible, on the team approach.

However, this may not be easy to achieve. When support is generated for research, those who go to bat for funds often want the money spent in their home towns.

You can think of instances where a pressure group has tried to interest experiment station leaders in a new project. State leaders didn't respond because they either didn't have the resources or preferred to use them for other work. The pressure group turned to Congress and obtained funds for a new Federal laboratory.

New work will be cooperative with the State experiment station program when possible. This is particularly true of developmental work -- the kind that usually has the most vigorous backing of local groups.

We can also think of many examples of how responsive State leadership has turned intensive pressure for research to good account. An example close at hand is the agricultural adjustment program at Iowa State. It's meeting local needs and contributing to the growth of economic knowledge.

Balanced Research

With all our proud gains in agricultural science, there's still a marked lag in ideas -- acceptable ideas -- for adjusting production to markets.

Our farms continue to produce far more wheat, cotton, and feed grains than we can use or sell or even give away without offending friendly countries that are also producing abundantly.

And the farmers are paying the penalty for this abundance. One measure of the cost can be seen in a comparison of the index of "real income" of farm workers with that of city workers.

For industrial workers over the past eight years, there has been a rise in "real income", a rise of 19 points -- from 110 in 1950-51 to 129 in 1957. That's in terms of 1947-49 dollars.

For farm workers during that same period, there has been a decline in "real income" . . . a drop from 96 to 84. The gap between the income of the city worker and the farmer has widened. And while farm income is somewhat higher this year, it is still many points below that of the city worker.

We know the decline in real income for farm workers is tied in closely to the world market . . . to changes in world demand for food and fiber . . . changes brought about by a rise in productiveness in other agricultural countries and by increasing competition from other raw materials.

What can the farmer do about it? He can do three things: (1) he can leave the farm; (2) he can supplement his income with work away from the farm; (3) or he can increase efficiency in his farm operations and do a better job on the farm.

He can leave the farm . . . follow the thousands who are moving to town every year. This isn't a new development. There's been a drop of nearly 10 million in our farm population since the big exodus began about 20 years ago. There's no indication the shift from farm to city will be reversed.

In many parts of the country, farmers are able to supplement their income with work in industry. Last year, off-farm work accounted for about a third of every dollar of income reported by farmers.

Another adjustment farmers can make is to stay on the farm . . . stay on the farm and try to do an even better production job than before . . . by adopting practices that convert depleted soils to richer lands . . . by using more chemicals . . . insuring a year-round supply of moisture. Look what's happened here in Nebraska! In the past three years, farmers have dug nearly 10,000 irrigation wells.

And here, as in other parts of the country, operators are enlarging their farms. They're "going by the book" to combine many good practices that assure high yields.

Nationwide, the result is that we continue to set records. Crop output this year was about a tenth larger than in '57, and a new high. Yields per acre were up some 12 percent. The prospective wheat carry-over is the biggest in history. And our supplies of food fats this year will reach nearly 14 billion pounds.

What about next year and the years immediately beyond?

We actually don't know how the farmer weighs price with other factors in his decision to plant. Here in Nebraska, Dr. Kanel and Dr. Hassler are making progress in studies that may throw some light on the question.

We've moved forward in agriculture on the premise that each farmer could adjust automatically to change . . . change in technology that has multiplied the productivity of his farm . . . change in industrial technology that has brought highly competitive new products into markets where he has traditionally sold . . . and change in political events -- in the transition from war to peace -- that has brought him into competition for markets with farmers around the world.

Our farmers have made adjustments. But too often the adjustment has been costly to the farmer and his family.

In 1955, when Congress amended the Hatch Act, it was specified that the policy of Congress is to promote a sound and prosperous agriculture and rural life. This is indispensable to the maintenance of maximum employment and national prosperity and security.

We have a responsibility in agricultural research for building up knowledge that helps farmers adjust to change.

There's a serious gap in our knowledge of the theory and methods for measuring the impact of technology on productivity and on farm income in the aggregate. A vast amount of research -- basic research in economic measurement -- must be done before we can predict the effects when X percent of farmers put new technology to work.

Another research approach to adjustment is through research to find new uses for farm commodities, and along with this, research to fit farm products to new demands

We're stepping up our investments in utilization research. The 85th Congress voted additional funds for studies to find new industrial uses and cut processing costs of farm commodities. The appropriation of $19 million for this work in fiscal '59 represents an increase of $3.2 million.

Biochemists are just beginning to chart the marvelous world of chemicals in agricultural commodities. Already many of our ideas about the chemical make-up of farm products are being revised.

To cite only one example: scientists have achieved a major break-through with techniques for separating the proteins in gluten. New analytical techniques have given them a much clearer picture of the constituents of the material that gives wheat its unique quality for bread and other uses. The findings will have implications for all research in wheat.

Our progress is like that of the road builder. A four-lane highway causes serious difficulties when it pours heavy traffic into bridges or sections of road with limited capacity. Our task is to plan research so that when there's a marked improvement in technology at one point, there will be concurrent gains all along the line . . . in production, in processing, in new uses, and in marketing.

Administrators of research are finding that it may help to look at what goes on in their own decision making. This was one of the things we considered last month at a conference on "The Science Executive in Government."

It was my privilege, as one of two representatives of USDA, to attend the conference in Williamsburg, Va. It was the fifth in a series for executives in the Federal Service . . . sponsored by the Brookings Institution under a grant from the Ford Foundation.

Twenty-three of us from 18 Federal agencies spent a strenuous two weeks attending lectures, reading, and discussing the philosopical aspects of questions that ranged from the impact of science on the world today to what makes the scientist tick.

As all good exploratory studies do, our discussions raised far more questions than they answered.

Research has become big business and must be subjected to the same management principles of other big organizations. There must be definite lines of command to move from the tactical to the strategic phases of the program.

Can the initiative of the scientist be preserved in this type of organization?

What's the effect of big government on research and education? Scientists are now working under government contracts at every stage -- from basic studies to the development of hardware. What happens eventually when a large share of creative ideas of our times must be reviewed in Washington before there are funds to explore them?

We were told by experts on the Soviet Union that Russia is gaining strength and will play an increasingly dominant role in the world of science? Can we keep pace?

What kind of national organization will be required to further our scientific efforts? As you know, the National Science Foundation was established in 1950 "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences."

It has become a force for the coordination of science in public and private agencies. Should it be given additional powers?

The creation of a new position of scientific advisor to the President, currently filled by Dr. James Killian, is a recognition of the growing impact of science on government and society.

The new Federal Council of Science and Technology reflects the growing use of scientists as advisors. It also shows the need for strengthening the Federal mechanism to maintain balance in the science program.

We shall see further debate in the new Congress on the question of a Department of Science. Truly, science is coming of age in our modern society.

Pointing to the Future

The long range research, now underway throughout the Federal-State network, is pointed to the needs of our society in the latter part of this century. It's based on our belief that the population of this country will continue to expand at the same rate it has in the past. The best estimates are that by 1975, the population of the United States will be 230 million people -- an increase of nearly 40 percent over that of 1955.

What will be required of research . . . to sustain productivity that meets rising demands . . . to promote a sound and prosperous agriculture . . . to strengthen our free economy and democratic processes to serve a space age?

These are the things that concern us as we draw up plans for the future . . . as we blueprint new research and make decisions to terminate or to continue going projects.

Of this we can be sure: all of us can contribute -- the people now doing research now in the developmental stage, those working on the frontiers of knowledge, and those of us whose chief responsibility is administration and policy. The task calls for our most strenuous and imaginative efforts.

Every Citizen's Stake in Our Agricultural Program 1/

It is a pleasure to meet with you here at the Stark County Fairgrounds. I thank the Canton Chamber of Commerce and your Congressman, the Honorable Frank T. Bow, for inviting me to come here to talk about agricultural research and related programs which affect the life of every citizen.

In our rapidly changing society, there are many problems about which every citizen ought to be intelligently informed. It is fortunate that we have leaders in many of our communities, like your Rural-Urban Committee here in Canton, who see the importance of focusing public attention on our increasing number of mutual farm and city problems.

In the days when U. S. 30 was the main highway connecting the East and Middle West, I marvelled at your busy industries whenever I drove through this city. Since then, you have made tremendous progress in the quality and quantity of goods you deliver, progress that has had much to do with our Nation's great technical advances.

For example, the high alloy steel that you make right here in Canton has helped increase the efficiency of modern motors and power equipment. On the farm this has meant better tractors, better hay balers, better harvesters, better electric equipment. It has meant an entirely new concept in living standards and home building. And it has brought greater mobility to everyone.

Just as the coming of technology led many farmhands to find job opportunities in cities, so this increase in mobility--also born of technology--is now encouraging more people to make their homes in rural areas. With good roads and good automobiles, many farm boys and girls can be employed in urban industry and continue living on the home farm. At the same time, city workers and business people are finding a freer and richer home life in the country, far from where they work. The old dividing lines between rural and urban communities are fading fast. Population experts predict that by 1975 about half the people in the United States will again be living in the country. As that time approaches there will be more and more problems of mutual concern to rural and urban residents.

Our local, State, and Federal Governments were founded on the traditions of rural democracy. It represented a way of life in which freedom of the individual within the framework of conscientious self-discipline was the primary goal of Government. This is the way of life and Government which most Americans have expressed a determination to retain.

In the transition we are making to a new kind of urban society, we need to remember those elements that first made us free and strong. A basic one has always been free inquiry and discussion--the right to ask questions about the

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1/ Talk at Farm-City Chicken Barbecue, Stark County Fairgrounds, Canton, Ohio, September 30, 1959, given by E. C. Elting, Deputy Administrator for Experiment Stations, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C.

problems we face in the community, the State, and the Nation, the right to learn what the alternatives are for solution of our problems, and the right to reach decisions on the basis of the best facts available.

In the past two weeks our Nation has been host to a prominent visitor who represents another part of the world and another way of life, different from ours. There are many things Americans learned from his visit.

It is significant that Chairman Khrushchev showed a great interest in U. S. agricultural science and farm production. We need not go far to ask why. In the Soviet Union, which has many scientific achievements to its credit, one farm worker still produces only enough food and fiber for himself and four other people. That's about where we stood when our agricultural experiment stations and Federal research program were getting organized in the 1890's. But in the United States today one farm worker produces enough food and fiber for 23 persons. Mr. Khrushchev knows that agriculture's abundance here in America in no small measure accounts for the industrial growth and total strength of our economy. It is highly important for him to find out why 12 percent of the people in the United States can produce enough food for the 100 percent and with a diet high in protein--and why it takes 50 percent of the people in the Soviet Union to produce a diet substantially lower in the meat type of human protein.

It struck some of us as a paradox that while Chairman Khrushchev demonstrated a zealous interest in our farm productivity, some of our people here at home have been questioning the value of our agricultural programs and institutions. Recently, the Kansas City Star, in an editorial entitled "The Farmer Is Still An Important Citizen," summarized this situation.

"The public has become accustomed," the editorial said, "to day-by-day arguments over farm programs, surpluses, subsidies, and parity. No wonder many people who are not familiar with the situation look upon the farmer as a man who can't run his own business."

The editorial then listed some pertinent facts assembled by Dr. C. P. Wilson, Director of the School of Agriculture at Kansas State University and Assistant Director of the Kansas Agricultural Experiment Station. (I quote):

> "Agriculture is the biggest buyer, seller, and borrower in the United States.
>
> "The inventory of farm machinery alone is greater than the assets of the American steel industry and five times that of the automobile industry.
>
> "Agriculture uses 6 1/2 million tons of finished steel a year--more than is used in a year's output of passenger cars. It consumes 17 1/2 billion gallons of crude petroleum--more than is used by any other industry--and 285 million pounds of raw rubber--enough to make tires for 6 million motorcars. Agriculture takes 22 billion kilowatt hours of electrical power--more than enough to serve Chicago, Detroit, Baltimore, and Houston for a year.

"Each year farmers purchase farm supplies worth about $16 billion.

"The agricultural plant each year increases its use of capital, of science and technology, of management and research.

"There are twice as many jobs in industries that serve farmers as in farming." (End of quotation.)

These are facts you can give your friends who may ask, "Why an agricultural experiment station, why an agricultural extension service, why those programs authorized by Congress in the name of the farmer?" Without the application of science and technology to farming, both farm and industrial productivity would face decline.

An important product of the rural civilization out of which our Nation grew is the State-Federal cooperative system of research, education, and extension teaching. This system is based on such milestones of Federal law as the act "to establish a Department of Agriculture" of May 15, 1862; the Land-Grant College Act of July 2, 1862, "donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts;" the Hatch Experiment Station Act of 1887; and the Smith-Lever Act of 1914, providing Federal support for agricultural and home economics extension work. In 1955, when Congress amended the Hatch Act, it stated that it is "the intent of Congress to assure agriculture a position in research equal to that of industry, which will aid in maintaining an equitable balance between agricultural and other segments of our economy."

You people here in Ohio are particularly fortunate in that you have had through the years a well-balanced distribution of rural and urban communities. Although Ohio today has only 8.2 percent of its population on farms, the State continues to rank high as an agricultural producer.

Dr. L. L. Rummell, who will retire next December as Dean of the College of Agriculture and Director of the Ohio Agricultural Experiment Station, has through his entire career been an able crusader for mutual farm and city progress. Through his leadership--first as a farm editor, then as a business man, and since 1947 as your agricultural dean and director--rural-urban cooperation has become popular in Ohio.

During his term as Dean and Director of the Agricultural Experiment Station, Dean Rummell has been most ably assisted by his Associate Director, Dr. W. E. Krauss. It is a pleasure to say that I have for many years had close professional relations with Dr. Krauss. He is not only an able coadministrator of your experiment station, but also Chairman of the Agricultural Board in the Division of Biology and Agriculture of the National Research Council. This Council represents the Nation's top-level leadership in science.

Today's rural-urban society needs the competent leadership in agriculture such as that given by Ohio State University and the Ohio Agricultural Experiment Station. And it needs the programs authorized by Congress for the benefit of both rural and urban communities alike. I recommend that you become more intimately acquainted with the program of your agricultural college at

Columbus and of your agricultural experiment station headquartered at Wooster, just next door in your neighboring county. The Ohio station ranks high among the great agricultural research centers of the world.

A week ago last Friday I was over at Lafayette, Indiana, where Purdue University dedicated its new Life Science Building. Governor Handley told us that Indiana is assured of continued growth through research, especially in the life sciences, because of the high quality of the faculty and staff. What he said of Indiana likewise applies in Ohio and in every one of our 50 States. On that occasion, also, President Elvehjem of the University of Wisconsin said that with the current emphasis on atomic and space science, the tremendous achievements of the biological sciences are frequently overlooked. He mentioned the extended life span of man, the multiplication of the number of people that can be fed by one man's efforts, and the reduction of disease and malnutrition.

Without doubt applying science to agriculture provides the cornerstone of high living standards and all-over productivity for people. But it would be a mistake to attribute all of it to science alone. Scientists from many countries have contributed and continue to contribute to the knowledge we draw on in agricultural production. But another key to our tremendous farm production progress lies in the political system of Government established under our early rural society. It included the separate administration of Federal, State, and local Government--but also close cooperation between them. There is no finer example of harmonious cooperative effort by the various levels of Government than in agricultural research, cooperative extension work, and our broad agricultural marketing and regulatory programs.

For a continuous flow of properly trained scientific personnel for agricultural research, both the State and Federal research establishments rely to a large extent on the land-grant colleges and universities.

This joint research-educational effort of the USDA--land-grant system has won the general public's confidence and receives a great deal of support from private organizations. Agricultural research, whether conducted by the State stations or by the Department, is carried on in close cooperation with farmer interests as represented by the various farm organizations and cooperatives, with scientific societies and institutions of higher learning, with agriculture-related business and industry, and with citizens' groups generally. The basic objective is a healthy economy for the United States.

Since this is a Farm-City event, let me tell you briefly about the theme USDA is suggesting for the 5th Annual National Farm-City Week, to be observed November 20-26. The theme is WATER FOR FARM AND CITY.

Naturally, farm producers are concerned from the standpoint of water needs and uses on the farm, including irrigation. But urban and industrial communities are concerned also.

In 1950, we had twice as many people using water as we had in 1900. And our per capita use of water was almost twice as much. It rose from 600 gallons a day in 1900 to 1,100 gallons a day in 1950. Total water use in the United

States quadrupled from 1900 to 1950. It is expected to double again by 1975, when per capita consumption is expected to reach 1,800 gallons.

Water is vital on the farm, in the factory, and in the home. With a steadily rising population it may well become the great limiting factor in all production and all progress, unless the public in every community takes intelligent action.

We need research on water, such as that done cooperatively by the Department of Agriculture and the Ohio Experiment Station at Coshocton and in other parts of the State. An extensive research program on development of farm ponds and use of farm pond water for domestic purposes is under way in southern and southwestern Ohio. Your State has made valuable contributions in devising new practices adopted by the national soil conservation program.

In teaching in your colleges and high schools, the activities of your State extension service, and the Federal Soil Conservation Service in Ohio all rely to a considerable extent on research findings of your agricultural experiment station. You'll find that if you take up the matter of soil and water conservation as a joint rural-urban activity, it will contribute much to planning for the future of Stark County.

As agriculture and industry prosper, as technology brings fundamental changes to our society, a major problem faced in our new rural-urban community is that of developing human resources. In 1955, representatives of the Federal Departments of Agriculture, Labor, Commerce, Interior, and Health, Education, and Welfare, also of the President's Council of Economic Advisors, announced formation of a Committee for Rural Development. Under Secretary True D. Morse of the Department of Agriculture is Chairman. The committee sponsors what is now generally referred to as the Rural Development Program. Through this program, activities have been undertaken in rural communities aimed at identifying area problems and sponsoring programs for the conservation of human resources in the area.

The program has been active here in Ohio since 1955. Cooperative extension leadership has had much to do with it. In counties where work is now under way, reports indicate that people are taking a more positive attitude toward agricultural, industrial, and community improvements. Where people are serving on committees to analyze and identify their problems, they have made changes in farm practices and family living, and in some cases, through stimulation by the Small Business Administration have established new industries.

In counties where the program is in full operation, it is engaged in a wide range of activities, from getting tree seedlings established to helping farmers adjust from full-time to part-time farming. It is helping families and communities install better health facilities in their homes. Better health conditions have been encouraged through sanitary installations and health checkups carried on through Public Health Service facilities. Great emphasis is being placed on more effective vocational education for the youth in these areas.

Another program that should be of universal interest is that of the Agricultural Marketing Service.

Agricultural marketing includes almost everything done to farm products from the time they are harvested until they are consumed. More people work off the farm, marketing farm products, than on the farm, growing them.

Americans buy, each year, around $100 billion worth of products that started out on farms somewhere. That's more than one-third of all the money spent by consumers. Three-fourths of this bill for farm-derived products goes for marketing.

The first job of the Agricultural Marketing Service is to provide a sort of economic intelligence service.

This consists of reports on how much of what kinds of crops and livestock farmers plan to produce--followed through the year by reports on actual production of crops and livestock, prices paid and received by farmers, and a great volume of other needed statistics. They include figures on how much of each major kind of food we are eating, per person, and the differences between the price consumers pay and the prices farmers get, which are the charges for the many and varied services that make up marketing.

This economic intelligence helps the farm producer fit his production and marketing to the demands of his customers in the city. It helps marketing agencies do a more efficient job of storing and hauling farm products, of changing them into food and clothing, of packaging them and selling them.

The consumer shares along with the producer in the benefits.

Urban people also share the benefits from marketing research. It includes studies designed to expand farm markets, to find out the exact qualities or characteristics that buyers of farm products want, and to increase the efficiency of marketing.

Research of this type has contributed to savings of millions of dollars a year in the packing and handling of various fruits and vegetables, in the handling and storing of grain, and in the marketing of other products.

Food distribution programs, also a responsibility of the Agricultural Marketing Service, benefit the vast majority of urban people. They include the school lunch program for more than 14 million children and the special milk program for schools, summer camps, and other children's activities. Surplus foods are being distributed through State agencies to 1.4 million needy persons in institutions and to 5.7 million needy persons in family units. And the Plentiful Foods program attempts to reach everyone with its messages about foods currently abundant at prices attractive to the consumer.

Consumers benefit directly from Federal grading of many farm products. We look for the U. S. Grade mark on butter, eggs, beef, poultry, and canned or frozen fruits and vegetables.

Another program touching every consumer is Federal meat inspection, conducted by the Agricultural Research Service.

With modest beginnings in 1906, providing supervision in only 163 meat processing establishments located in 58 cities, this program has grown to affect the lives of nearly every city and rural dweller in the country. Today, over 1,300 establishments operate in some 530 cities and towns. Over 80 percent of the meat produced in this country originates in establishments operating under Federal meat inspection. This program assures the delivery of only wholesome, appetizing meats and meat products to consumers.

Meat products offered for import into the United States must come from countries whose inspection standards have been found comparable with ours. In addition, all imported meats must be inspected and passed at ports of entry. Not only is our human population protected from unwholesome meat, but our livestock industry is able to enjoy freedom from devastating livestock diseases existent in some parts of the world.

Last year, with passage of the Humane Slaughter Law, the Federal meat inspection service assumed a new responsibility--that of developing and administering this law.

The Agricultural Research Service of the Department of Agriculture also has the important task of protecting the United States from the entry of foreign animal and plant pests and diseases. You may think that we already have an abundant share of alien insects and plant diseases. Nevertheless, there are scores of other destructive foreign pests that frequently arrive by ship and plane. To turn these back before they can gain entry, we maintain a corps of animal and plant quarantine inspectors. Stationed at ports of entry and cooperating with the Customs Service, Immigration Service, U. S. Public Health Service, and State regulatory officials, these inspectors are our first line of defense against international pest migrants.

Plant quarantine activities in the Central States have been profoundly affected by the opening of the St. Lawrence Seaway. In a recent month, Cleveland port inspectors examined 65 vessels compared to 35 in the same month of 1958. Forty-one of the 89 vessels unloading at Chicago in the same month were direct foreign arrivals, compared to 29 such arrivals in 1958. Arrivals at other Lake ports are increasing proportionately.

The khapra beetle, a serious pest of stored grain, was among the first passengers through the Seaway. For an infestation of this prolific grain-destroyer was found in a German freighter arriving at Cleveland on June 27. This necessitated the fumigation with methyl bromide of the holds of the ship. As a result the Department has received many letters from grain, milling, and railroad interests in the Great Lakes region, pointing out that the new gateway to commerce makes the grain industry much more vulnerable to the introduction of foreign pests.

It is imperative, then, that the Grain Belt of the United States be protected from this and similarly destructive foreign introductions.

If time permitted, we could discuss other programs which have an impact on large segments of our population--the licensing and use of pesticide chemicals in agricultural production--animal disease control and eradication, farm

credit, rural electrification, commodity stabilization, the servicing of farmer cooperatives, the Soil Bank, and many others. Every citizen has a stake in these programs.

Ohio is one of our leading rural-urban States. It is second only to New York in manufacturing. It ranks ninth in the value of agricultural output in crops and livestock. This output is made by less than 10 percent of the State's population. Yet agriculture is your greatest single industry. It brings in more than a billion dollars annually, a figure equalled in only eight other States.

We must keep in mind that the agricultural industry in Ohio is not limited to farms. In fact, 35 percent of all labor in Ohio is associated with agricultural industry. There are 160,000 farm operators and about 300,000 total laborers on Ohio farms. Directly dependent on agriculture are 450,000 others engaged in processing and distribution of farm products, and 300,000 more producing and selling equipment and supplies used on farms.

We're all aware of the present rapid increase in our population and the predictions that this trend will continue. The Census Bureau estimates that by the year 2010 we may have 370 million people--more than twice the population we have today. This means that just to maintain our present diet levels 50 years hence, we will require twice as much food and other farm products as we're consuming today.

But the amount of farmland available is not likely to be increased much beyond the acreage farmers are now using. Some new land can be brought into production by various methods. But, as our population increases, considerable present farmland will go into urban and other nonfarm uses. Trends also indicate that our farms will continue to increase in size and decrease in numbers and that additional farm workers will seek part- or full-time employment in towns and cities.

In summary, then, we can expect that tomorrow's farmers--with only a little more land and less manpower--will have to produce for a rapidly increasing population, whose needs and desires will influence, more and more the kinds and qualities of products produced. Despite our present abundance, these demands will not be met unless ways are found to further increase efficiency throughout agriculture.

Today, the abundance, high quality, and economy of food in America cannot be matched anywhere else in the world. Mr. Khrushchev says he'll try to match it. But we may have confidence for the future. Back of our way of life and standard of living are educated farmers and public institutions that assure an educated citizenry in both rural and urban communities. This gives strength to America--to its prosperity, its security, its contributions to the peace of the world.

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500 Attend Rural-Urban Barbecue

U.S. Official Says Farm-City Relationship Vital to Future

[illegible]

Oct. 16, 1962

PANEL DISCUSSION: GOVERNMENT-UNIVERSITY-INDUSTRY COOPERATION IN AGRICULTURAL RESEARCH

Presentation by

E. C. Elting, Deputy Administrator,
Agricultural Research Service, USDA

This subject is of continuing significance to the membership of the Agricultural Research Institute.

I have bracketed the government research agencies -- primarily the U.S. Department of Agriculture -- and the university laboratories -- primarily State agricultural experiment stations -- as publicly supported research institutions, and have assumed that each has similar objectives and problems in developing cooperative relationships with industry.

In approaching the subject of cooperation in agricultural research, I should like to cite a few statistics that will help to put our discussion in perspective in relation to the total national effort in research and development. To say that this total effort has accelerated rapidly during the post war years is an understatement. Information recently released by the National Science Foundation indicates that during the decade 1951-52 through 1960-61, about $80 billion were spent for research and development in the United States. This figure is approximately double the amount spent during the preceding decade. Continuing the trend, an additional $15 billion is estimated to have been obligated during the 1961-62 fiscal year recently ended.

Some breakdown of these gross figures will help to understand their significance. The total research and development funds amounted to 1.41 percent of the gross national product during 1953-54, but had increased to 2.78 percent during the year 1960-61. It is obvious, therefore, that there is increased emphasis on research and development as a major component of the Nation's economy.

If we reexamine these data as to the source of our research and development dollars during 1960-61, the last year on which detailed statistics are reported, here is what we find: Out of approximately $14 billion in all, the Federal government provided $9.2 billion, industry $4.5 billion, colleges and universities $.2 billion, and other non-profit institutions $.1 billion.

American industry spent some $10.5 billion of this total, $6.1 billion of which was provided by the Federal government and $4.4 billion by industry itself.

Examining the distribution of these research and development expenditures by industry, we find that the latest available data show 4% of the total expended for basic research, 20% for applied research, and 76% for development. Comparable figures on the use of the Federal research appropriations to the USDA show approximately 28% for basic research, 68% for applied research, and 4% for development.

Talk before the annual meeting of the Agricultural Research Institute, Washington, D. C., October 16, 1962.

There is evidence that expenditures by the State agricultural experiment stations break down in this same general order.

One other comparison seems significant. Of our total funds for research and development, the Federal government provides about 64%, State governments and non-profit institutions about 3%, and industry about 33%. However, in research and development relating to food, agriculture, and forestry, the Federal government provides about 22% of the total, States about 20%, and industry 58%.

Thus, as we approach the subject of cooperation between public institutions and industry in the field of agricultural research, we recognize the very substantial contribution which industry is making to this area.

The program committee has posed a number of penetrating questions to this panel. These questions are largely subjective in nature and it is entirely possible that the answers which I or other members of the panel may give to these questions will not be acceptable to you. We trust, however, that they will stimulate discussion of these important questions to the end that more effective relations and stronger cooperation may be developed among these three partners in agricultural research.

They ask first, "Is it true that more and more research projects are worked on cooperatively by government, universities, and industry?"

Only limited statistics are available to answer this question in the strictly comparative framework in which it is asked. Research has expanded significantly in recent years, in both the privately and publicly supported sectors, so that even if there has not been a significant percentage increase in cooperation, there has been a significant increase in the number of cooperative projects. Actually, there is evidence that an increasing percent of industry research is correlated with similar research conducted by the State stations and the Department. However, there is still room for further cooperation, since it was estimated last year that only about 10% of industry's research was thus highly correlated.

In response to the second part of this question as to how strong is this trend of increased cooperation, I can only express the opinion "not strong enough." I urge that effort be made to accelerate the rate at which these cooperative relationships are developed. In making this statement, I tend to give an affirmative answer to the second question, which asks, "Is there a need for general cooperation in agricultural research between these various agencies?"

The following areas of need are described to support my affirmative answer. Sound economics dictate that there should be close cooperation between these research agencies wherever mutuality of interest exists. It is the only way to assure maximum returns for research and development dollars whether they be derived from public or private sources.

The evidence of strong cooperative relations between industry and our public agencies tends to promote greater public confidence in agricultural research. It may well be that this need for gaining public confidence is one of the most compelling reasons for close cooperation. We can point to many sectors where it is highly essential in terms of the public image and public understanding of vital problems that this type of close cooperation between our public and private agencies should exist.

To support this point of view, I quote from a recent communication from Dean Leland G. Merrill, Jr., New Jersey College of Agriculture, commenting on a paper which he presented at a recent meeting of the National Agricultural Chemical Association at Spring Lake, New Jersey, on September 5 of this year. He says, "To me, the major problem is not in the technical phases, but that a cultural gap exists in public knowledge of use of chemicals." He sees this as a serious and long-term problem which should be systematically attacked by all the agencies concerned.

What has been said of pesticide chemicals is quite as true of the role of saturated fats in the human diet or of additives in the rations of farm animals. In all of these areas where our knowledge is inadequate, the first obvious need is for continued objective research to seek sound answers to complicated problems. Joined with this effort is the need for the use of every skill at our command in creating a proper public understanding of the problems and issues involved.

Your program chairman then moves to questions regarding advantages and disadvantages which surround the development of cooperative effort. I cite the following areas in which we can point to definite advantages of close cooperation between industry and public research. While the illustrations used are taken from a 1960 study of industry-Department cooperation, we know that many of these examples and others of comparable significance are applicable to industry-Experiment station cooperation.

a. Permit more intensive work and speeding up of research achievement. Many of the research problems with which the Department is concerned require intensive work to obtain positive results in a short time. Industry can and has contributed in some of these efforts. For example, with funds and facilities provided by the Cotton Council of America for research at Iguala, Mexico, it has been possible to cut the time in half for the initial development of segregating populations of cotton and subsequent release of a commercial variety resistant to bacterial blight, and to speed up the development of lepidopterous-insect-resistant and gossypol-free lines. At the Clemson, South Carolina, laboratory for ascertaining cotton qualities in spinning and weaving, the Council has provided funds to permit double-shift operations of equipment to speed the attainment of results.

b. Provide services of specialized personnel and facilities and equipment. In a number of the Department's research programs, industry is providing to a limited extent services of specialized personnel and, more generally, facilities and equipment. Cooperation on these items is extremely valuable. Pertinent examples are as follows: the American Sugar Beet Growers Association is supplying services of two scientists with unique background in monogerm sugar beet breeding and cytology to help evaluate hundreds of hybrid progeny, two additional professionals for chemical evaluations, equipment which is not available in the Department, and seed of new and promising varieties.

c. Expedite getting research results adopted by industry. When industry cooperates in research, results are likely to be more quickly adopted by industry. Close association of cotton gin manufacturers and Department researchers has speeded up the development of ginning equipment and, especially, modification of hundreds of existing gins. More spectacular has been the adoption of aerosol units. Following the development of the aerosol principle by Department scientists, industry has assisted greatly in the development of better units and in exploiting the results of basic research. From 1947 to the present time, the aerosol industry has increased production from 1 million to more than 400 million units annually.

d. Permit coverage of a larger number of problems. The Department is responsive to proposals from industry for research on cooperative projects of mutual interest which are in accord with the objectives of the regular programs. In these instances, industry may make available small amounts of chemicals and biological materials not available on the open market or supply limited radioactive tracer materials. The successful quest for a suitable antioxidant to help stabilize the nutrients in dehydrated alfalfa feed was realized through cooperation of many chemical manufacturers. Today's frozen citrus juice concentrate industry, with a cumulative product value exceeding $1.5 billion, stemmed from the cooperative efforts of the Florida Citrus Commission, many representatives of the industry, and Department personnel. In other instances the Department may supply only the know-how. The mutual sharing of ideas, manpower, materials and funds permits greater coverage of a larger number of problems.

e. Make important information and data accessible. An inestimable advantage accrues from access by Department scientists to information and data not otherwise available. Cost data from individual firms are absolutely essential for many market and price analyses. In other instances, data acquired by industry effectively supplement Department research. For example, the American Bankers Association semi-annually collects data from approximately 5,000 banks in agricultural areas to determine the adequacy of agricultural credit, delinquency of payments, major purposes for which loans were made, interest rates on new real estate and mortgage loans and associated agricultural problems. These data are made available to enable researchers to prepare more complete reports on farm costs and agricultural finance. Additional pertinent examples would include information supplied by industry making possible

the development of substantially improved procedures for conditioning and drying of cereal grains such as corn, wheat, and rice; and industry research and practical plant data in expediting USDA efforts to improve and stabilize flavor of edible products from vegetable oils and animal fats.

f. Provide more equitable financing for research. In view of the many segments of research for which public agencies are responsible and the urgent problems which have to be solved quickly, it is evident that funds and facilities are inadequate to meet all demands. For fiscal year 1960, for example, the Research Advisory Committees recommended a total of 670 problems on which research should be initiated or expanded. Appropriation of public funds permits the initiation or expansion of a relatively few of these recommended projects. Priority is given to projects having the broadest interests in terms of commodities, functions, beneficiaries or geographic distribution. Projects advocated by narrower interests may be undertaken only with financial aid from those most interested. Public financial support must, as a matter of equity, be limited where only a few primary beneficiaries are likely to be involved. Accordingly, industry's contributions in making available equipment and facilities, synthesis of and development of pesticides, antibiotics, and food and feed additives permit more equitable financing for research on specific projects. Similarly, market research on products grown by only a few farmers can hardly be justified on a large scale without their participation.

g. Lessen the demand for public funds to be appropriated for research. It is estimated that $20,000,000 are spent annually by industry in the synthesis and development of chemicals for the control of insects, plant and animal diseases, weeds and internal and external parasites of animals. The Department's responsibility in the over-all cooperative effort is for research on the final evaluation of the procedures and results submitted in substantiation of claims of efficacy, safety and compliance with legal requirements. Thus, with industry bearing a major share of responsibility and cost of the program, the demand for public funds for this research is lessened.

Legislators express the feeling that if industry were to do more, public agencies might do less research. This may be true provided the public is willing to wait until industry is ready to perform, disclose, or adopt research that could conceivably be done by industry. Actually, government research in such areas as marketing stimulates rather than replaces industry research. It is so highly dependent upon industry cooperation that the two supplement rather than substitute for each other.

h. Provide avenue for public-spirited groups or individuals to aid agriculture. Department researchers have profited in many ways from contributions to public research programs. Frequently, as might be expected, the donors also profit. Nevertheless, contributions from these sources have been valuable in expediting certain of our programs. Farmers often donate land for crop testing programs. Flocks of sheep and grazing lands have been made

available by public-spirited sheepmen to assist the Department in its studies to determine effects of environment and diet upon wool processing quality. Recently American interests donated facilities in Venezuela for screening the world collection of rice varieties to determine resistance to a destructive virus disease which at the time was not present in the United States. Likewise, recently a public-spirited citizen donated $145,000 in partial support for converting Dairy Herd Improvement data processing to electronic equipment.

There are disadvantages accruing from such cooperative effort only if we fail to recognize certain pitfalls that can become a deterrent to effective relations.

Most of those who make suggestions for new or additional work to Congress, to the Department, or to State stations have some knowledge of the kinds of research conducted in industrial laboratories. They do not usually urge upon public agencies work that industry is likely to undertake. The principal exceptions are large groups of individuals or small firms who are at a disadvantage in relation to large corporations that have their own research laboratories. Some suggestions come from leaders in industrial laboratories. They visualize the long-term public benefits from investigations which they do not undertake themselves, because the results cannot be protected for the short-term benefit of the firm.

Probably each of you, drawing on your experience, can point to certain areas where we need to be on guard in the development of cooperative relations. Some of these are expressed in a recent policy statement relating to the acceptance by the U.S. Department of Agriculture of contributions to research, as follows:

a. There shall be mutuality of substantive interest, with the exception that the public interest will be definitely served.

b. The research shall be directed toward the solution of problems of agriculture including the production, processing, utilization, distribution and consumption of the product of agricultural and forest lands.

c. The research, whether basic or applied, shall be designed to add to the fund of scientific knowledge.

d. Preference shall be given to research that promises the most widespread benefits. The objective of the research shall not be limited to the interest of an individual or single firm.

e. Research for which contributions may be accepted shall be within the boundaries of an agency's approved program. No research shall be completely supported by contributions.

f. Results shall be subject to public disclosure. Publication of research results is the usual, but not the only, method for assuring wide availability to the public. Patentable ideas, products, processes, and equipment developed

in the course of the research shall be reserved to the public in accordance with existing laws and regulations and this reservation shall be inserted in agreements covering research. Results shall not be presented in such a way as to constitute endorsement by the Department of any proprietary product or process.

I know that most experiment station administrators likewise have developed carefully drawn statements of policy under which their institutions will accept contributions from industry for the support of research.

The final point raised by your program chairman is whether industry burdens the State and Federal research agencies with too much product testing. I feel strongly that a categorical "yes" or "no" answer fails to recognize the many conditions that must determine the proper role of the public agency and of industry in developing the machines and products which make such important contributions to our expanding agricultural technology.

Let us consider the area having to do with the selecting and evaluation of pesticide chemicals for research and use in agriculture. The following excerpts from a recent report from the Department to an inter-Departmental committee established by the Director of the Office of Science and Technology, in my judgment, puts this problem in proper perspective:

> "The U.S. Department of Agriculture and the State agricultural experiment stations are interested in fundamental and applied research on the development of chemicals that may be useful in agriculture, especially those which have a low order of toxicity to man, livestock, wildlife, to crop and forest plants and soil microorganisms. ...
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> "Most of the chemicals ... are synthesized and developed by industry. In some instances, the public research agencies aid in their commercial development; in others, the chemicals have been discovered by public agencies with subsequent commercial development by industry. Department programs of synthesis and analysis relate for the greater part to long-term basic problems such as those resulting from chemical investigations of naturally occurring products, attractants, repellents, synergists and chemosterilants. They also relate to certain classes of chemicals of importance to agriculture or to specific pest control programs in which the Department is engaged.
>
> "The responsibilities of the public agencies include research on chemicals for which there is a limited market potential.
>
> "Department and State scientists obtain candidate chemicals from industry and from Federal and State agencies. Candidate chemicals are generally not accepted for screening unless they have been shown to possess biological activity. ...

"Upon completion of initial testing, the recipient laboratory submits a report of results to the supplier. The results of such tests by the USDA or State experiment stations are not to be published by the supplier or used for advertising purposes and do not constitute an endorsement of the candidate material by these public agencies. ...

"The results of laboratory and small scale plot tests form the basis for determining the potential value of the chemical. ... Arrangements for large-scale field evaluations may be made with industry if it is mutually determined that such evaluations are justified.

"Industry conducts toxicological investigations in its own laboratories or supports research by other laboratories. The Department of Health, Education, and Welfare alone or in cooperation with industry conducts further toxicological investigations. The Department of Agriculture and State experiment stations conduct and cooperate with industry in the appraisal of the effects of pesticides on livestock.

"In the complex investigations of the residue problem in relation to plant and animal products, the State and Federal agencies usually cooperate with the industrial firm developing the pesticide. ...

"Pesticide uses that are likely to affect adversely the honey bee and other pollinating insects require investigations to determine the effect of the materials on these useful insects. Observations on the effect of pesticides on beneficial parasites, predators, fish and wildlife are often made as pesticide materials are evaluated. ...

"No recommendation for specific use of a chemical is made until the chemical has been registered for such use by the Department of Agriculture in accordance with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act."

Time does not permit further exploration of this area. In the last analysis, the public interest must be served and both the private and public sectors must discharge their appropriate responsibilities. All of us have a stake in delineating those responsibilities.

It is my hope that the position indicated in my remarks to the questions posed by the program committee will stimulate a fruitful discussion here this afternoon.

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